SpaceX Dragon Spacecraft

Jim Rauf

SPACEX

1	Introduction: topics , some basics and rocket pioneers
2	SpaceX founding , Musk's vision, facilities, organization, personnel
3	SpaceX and NASA commercial funding
4	Falcon rockets and engines , Falcon 1, Falcon 9 and Falcon Heavy
5	**Dragon spacecraft , Cargo Dragon and Crew Dragon**
6	Super Heavy booster and engines and Starship spacecraft
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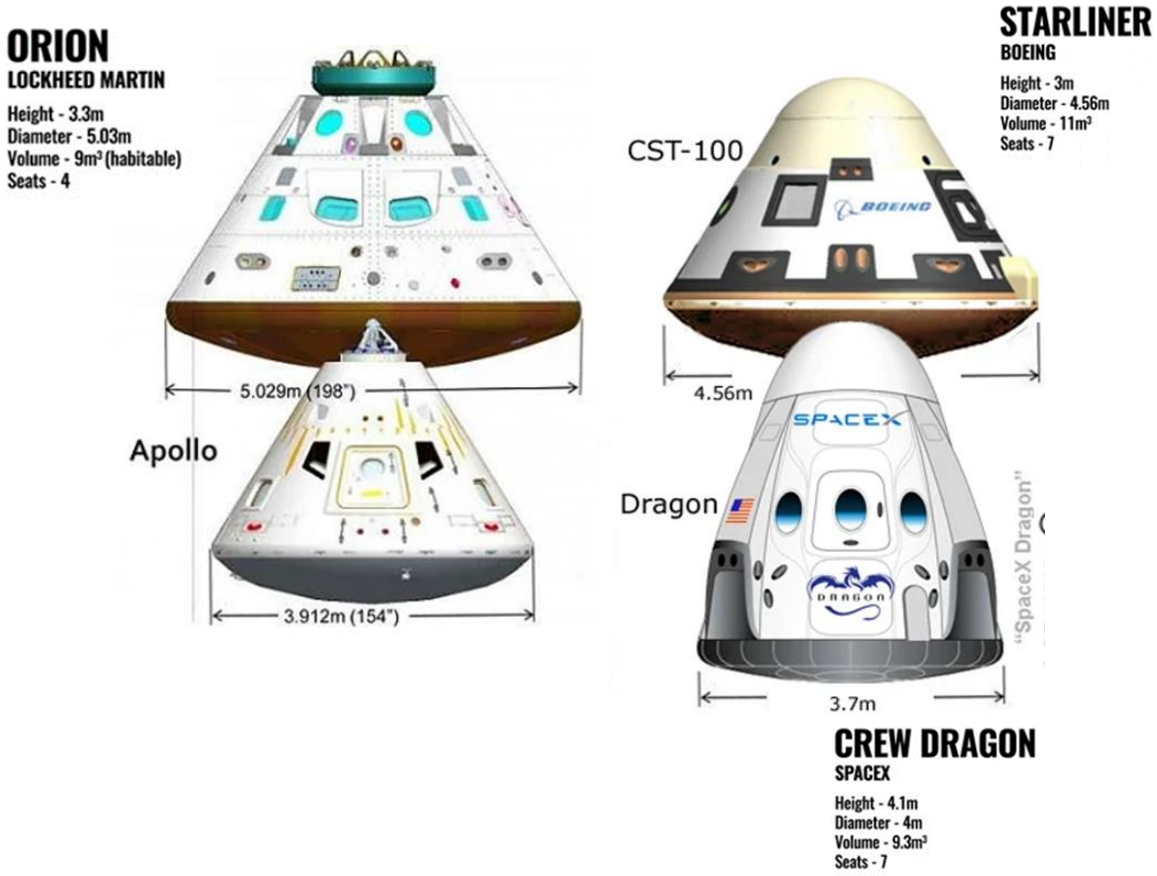
SPACEX Dragon Capsule Description and Comparison

- **SpaceX** began development of its **Dragon** spacecraft in **2004** using its own money
- Dragon is similar in configuration to previous U.S. space capsules
  - Mercury, Gemini, Apollo and Orion
- It has a blunt cone shaped ballistic shape
- It includes a non reuseable “trunk” with solar arrays for electrical power
- It has a heat shield made of a proprietary variant of the NASA Phenolic impregnated Phenolic Carbon Ablator (PICA) material
- It has a docking hatch
- Maneuvering thrusters-18
- It has a “built in” emergency escape system
- It is launched atop Falcon 9 rockets
- It is designed to parachute to a water splashdown



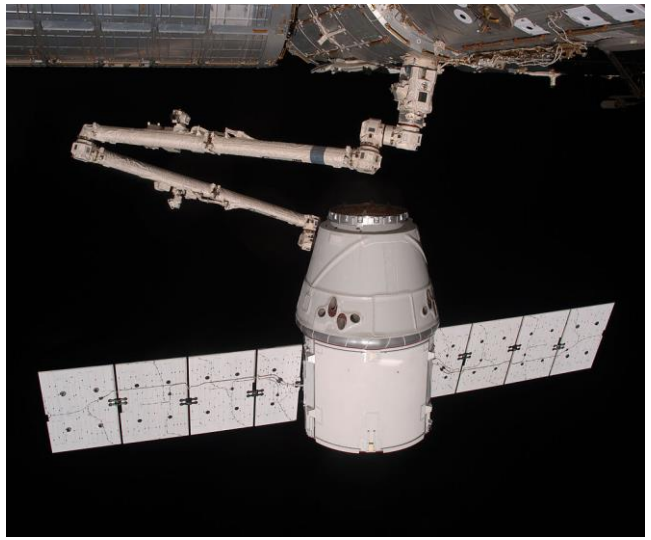
Dragon Capsule

- **SpaceX** vehicles' names must be "cool"
- The **Dragon** was named after "***Puff the Magic Dragon"*** in the ***Peter Paul and Mary*** song
  - Response to belief that **Musk'**s goals were out of reach
- In 2005 **NASA** began its **Commercial Orbital Transportation Services (COTS)** program to provide a means of proving logistical support for the **International Space Station (ISS)** using commercial space transportation services
- Phase 1 is called the **Commercial Orbital Transportation Services (COTS) Demonstrations**
- Phase 2 is a competitive procurement for **Cargo Resupply Services (CRS)** to support the **ISS**
- **NASA** payments are made only upon completion of progress **milestones** by its industry partners
- March 2006 SpaceX submitted the Dragon as part of its **COTS** proposal to provide
- August 2006 NASA announced **SpaceX** and **KistlerAerospace** had been chosen to develop **ISS** cargo launch services
- Initial plan was for **SpaceX** to do three demonstration flights between 2008 and 2010 and to receive up to $278 million if milestones were met
- December 2008 **NASA** awarded a $1.6 billion **CRS** contract to **SpaceX** with options to increase it to $3.1 billion
- The contract called for 12 cargo flights carrying a minimum of 20,000 kg (44,000 lb) to the **ISS**
- **Dragon's** first flight was in June 2010
- **FAA** issued a reentry license in November 2010

Dragon 1 Capsule

- December 8, 2010 first **Dragon** mission
  - Second **Falcon 9** flight
- Test of **Dragon’**s orbital maneuvering and reentry
- Mission was a success
- The **Dragon** was successfully recovered

- May 22, 2012 first **Dragon** mission with complete spacecraft
- First rendezvous mission with berthing with **ISS**
  - Time at **ISS** 5:17:47
- Mission was a success
- **Cargo Dragon** spacecraft flew 23 cargo missions to the **International Space Station (ISS**) between 2010 and 2020 before retiring
- It was not designed for astronauts



Dragon 1 and Dragon 2 Capsules

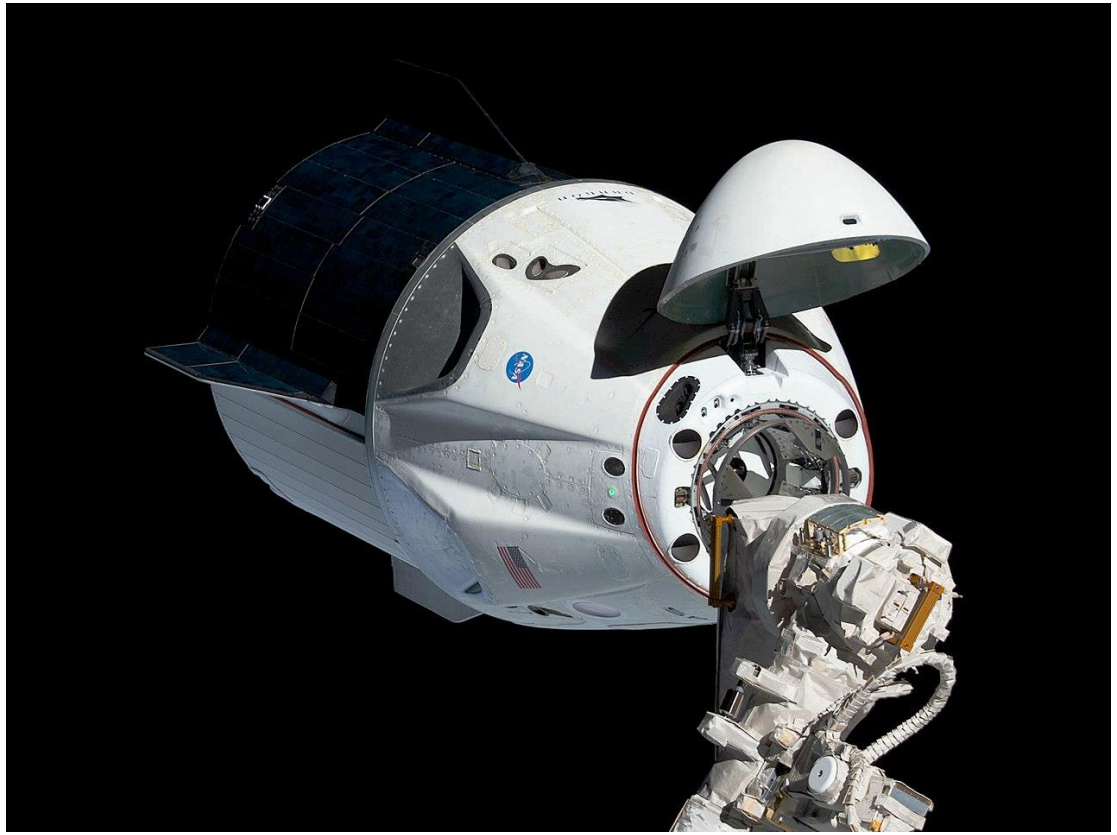
- In May 2014, **SpaceX** unveiled the seven-seat **Crew Dragon** concept
- It was developed in collaboration with NASA's **Commercial Crew Program**
- The **capsule** and cargo **trunk** stand around 26.7ft tall, with a diameter of 13ft
- The **Crew Dragon** is equipped with 16 **Draco thrusters** that maneuver the vehicle in orbit
- Each **Draco** is capable of producing 90 pounds of thrust in a vacuum of space
- If anything goes wrong during lift-off, the capsule has a **launch escape system (LES)** consisting of eight **SuperDraco** engines that each produce 16,000 pounds of force
- The **LES** quickly separates **Crew Dragon** from its **Falcon 9** launch vehicle

- **Crew Dragon** is a fully autonomous spacecraft that can be monitored and controlled by onboard astronauts and **SpaceX mission control** in Hawthorne, California

Dragon 1 and Dragon 2 Capsules

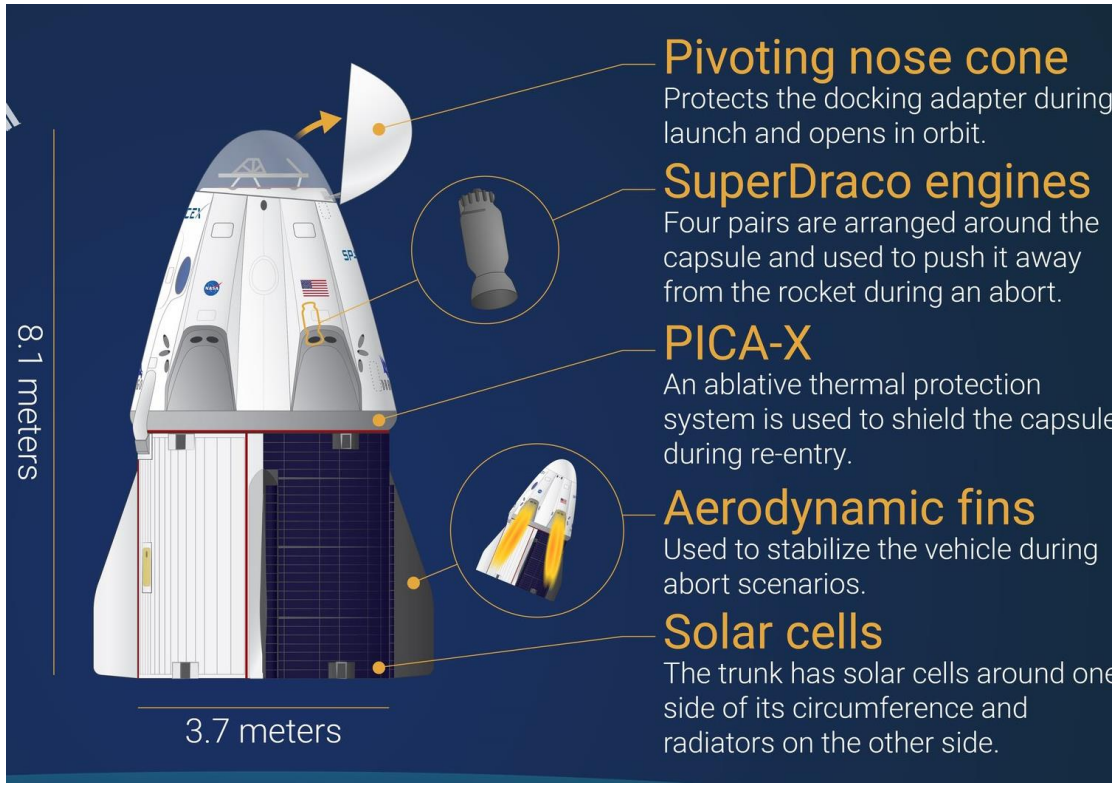
- **SpaceX** developed its **Dragon 2** spacecraft starting in 2014, with a cargo and crewed version
- It entered service in 2019 with the **Demo-1** flight
- First flight with astronauts on May 30, 2020
- First **Crew Dragon** operational flight was November 16, 2020
  - Four astronauts to the **ISS** for a six-month mission
- Ten **Crew Dragon** flights to **ISS** thru august 26, 2023
- Eight **Cargo Dragon** flights thru June 23, 2023

- Total **Dragon** flights
  - 42 launches
  - 38 visits to **ISS**
  - 20 reflights



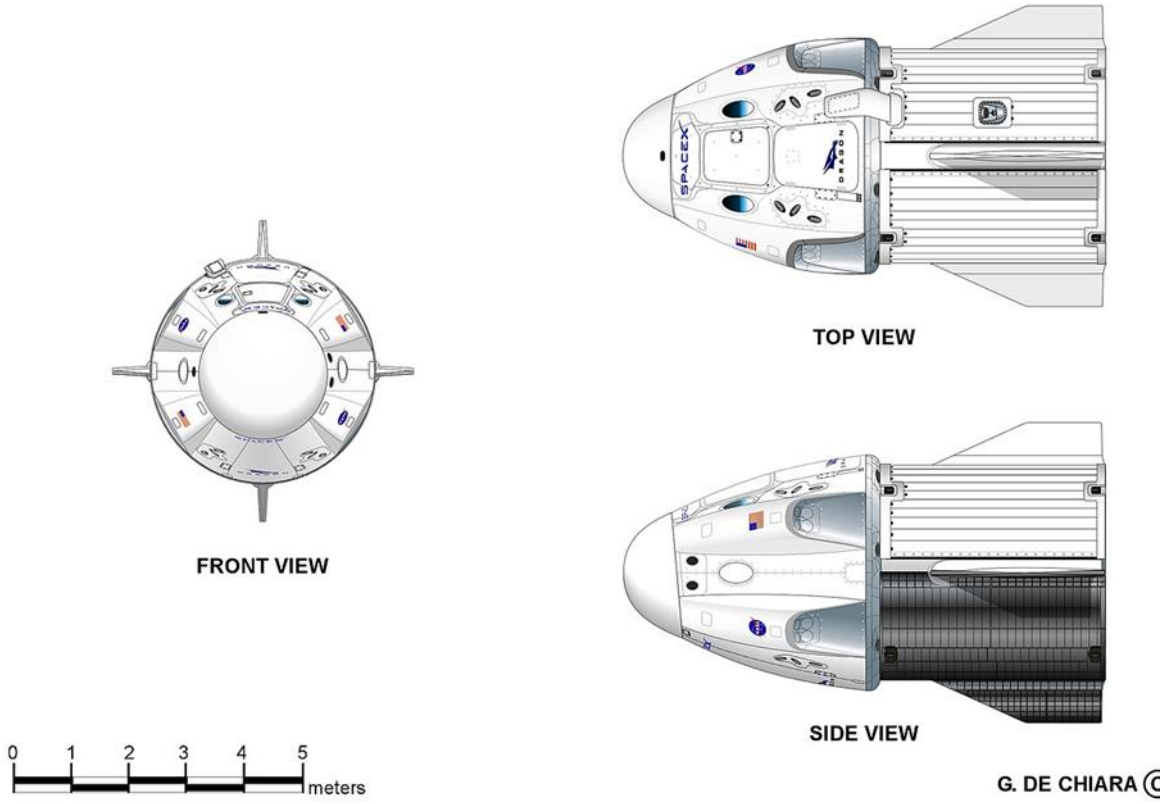
Dragon 2 Capsule

- **Dragon** is composed of two main elements: the **capsule**, which is designed to carry crew and critical, pressurized cargo, and the **trunk**, which is an unpressurized service module
- The capsule is subdivided into the **pressurized section**, the **service section** and the **nose cone**, which is opened once on orbit and stowed prior to re-entry
- Near the base of the capsule, but outside the pressurized structure, are the **Draco** thrusters, which allow for orbital maneuvering
- Additional **Draco** thrusters are housed under the nose cone, along with **Dragon's Guidance Navigation** and **Control (GNC)** sensors
- **Dragon's** trunk provides the mating interface for the capsule to **Falcon 9**
- On orbit, half of the trunk contains a **solar array**, which powers **Dragon**, and the other half contains a **radiator**, which rejects heat

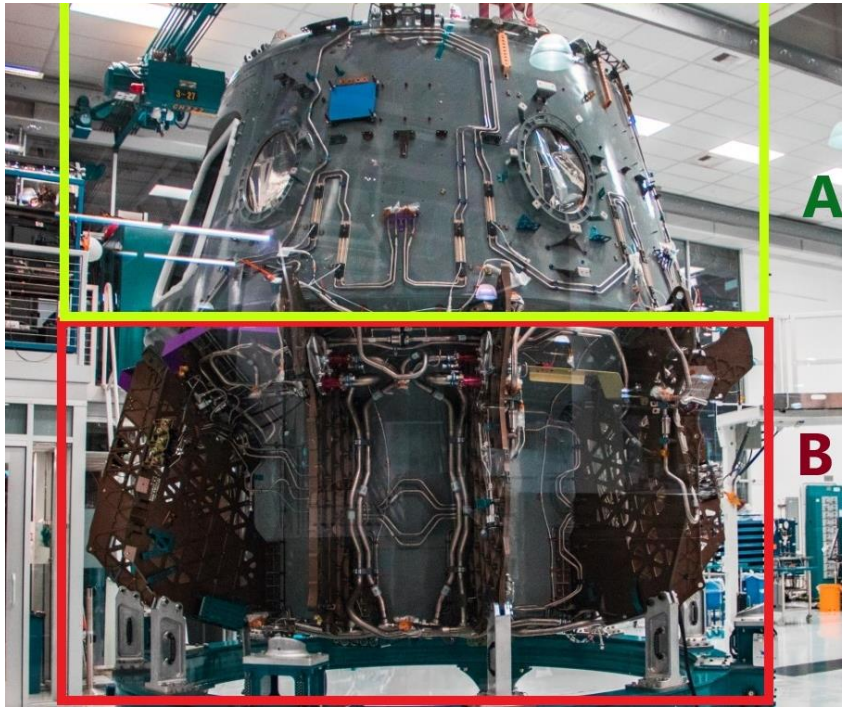


Dragon 2 Capsule

- Both the **radiator** and **solar array** are mounted to the exterior of the trunk, which remains attached to **Dragon** until shortly before re-entry when the trunk is jettisoned.
- **Crew Dragon** was designed with **three windows** so passengers can take in views of Earth, the Moon and the wider solar system right from their seats
- **Crew Dragon** has an **Environmental Control and Life Support System (ECLSS**) that provides a comfortable and safe environment for crew members
- During their trip, astronauts onboard can set the spacecraft's interior temperature to between 65 and 80 degrees Fahrenheit
- **Crew Dragon** features an advanced **abort system** with eight **SuperDraco** engines and a series of parachutes that can be activated instantaneously from the moment they are armed
- **NASA** and **SpaceX** are capable of supporting seven splashdown sites located off Florida's east coast and in the Gulf of Mexico



Dragon Capsules



A Pressure vessel:
Crew couches

B Aft equipment bay :
Stores equipment and supplies that are accessible within the cabin

- **Dragon's** structure is primarily made of **aluminum**
- **Dragon's** outer shell uses **carbon-fiber composites** to reduce weight while maintaining strength
- **Dragon's** heat shield material is **Phenolic Impregnated Carbon Ablator** (**PICA-X)**

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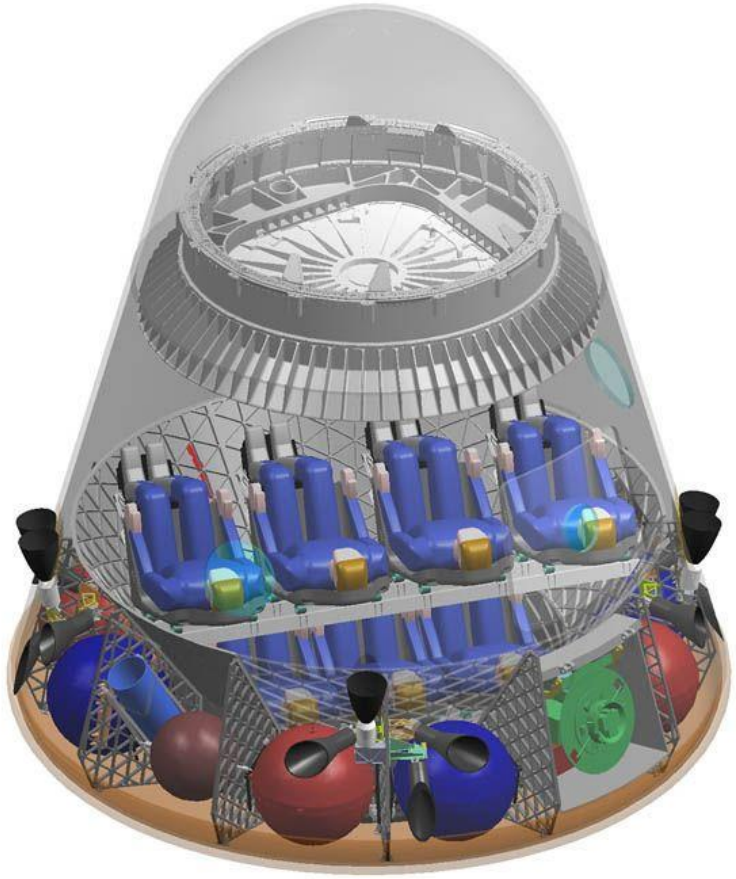
Crew Dragon Capsule



Interior

Dragon Capsules Specs

Length	2.9m
Diameter	3.6m
Sidewall Angels	15 Degrees
Pressurized Volume	$10m^3$
Unpressurized Volume	$14m^3$
Trunk Extension	$34m^3$
Sensor Bay	$0.1m^3$
Mass	4,200kg
Launch Paylaod	6,000kg
Return Payload	3,000kg
Endurance	Up to 2 Years
Maximum Crew	7
Avionics	Full Redundancy
Reaction Control	18 Draco Thrusters

Propellant	Hydrazine/Nitrogen Tetroxide
Propellant Mass	1,290kg
Docking Mechanism	LIDS or APAS
Power Supply	2 Solar Arrays – 1,500-2,000W
Power Buses	28V&120V DC
Batteries	4 Li-Polymer Batteries
Cabin Pressure	13.9-14.9psi
Cabin Temperature	10-46°C
Cabin Humidity	25-75%
Command Uplink	300kbps
Downlink	>300Mbps
Windows	Up to 4
Window Diameter	30cm

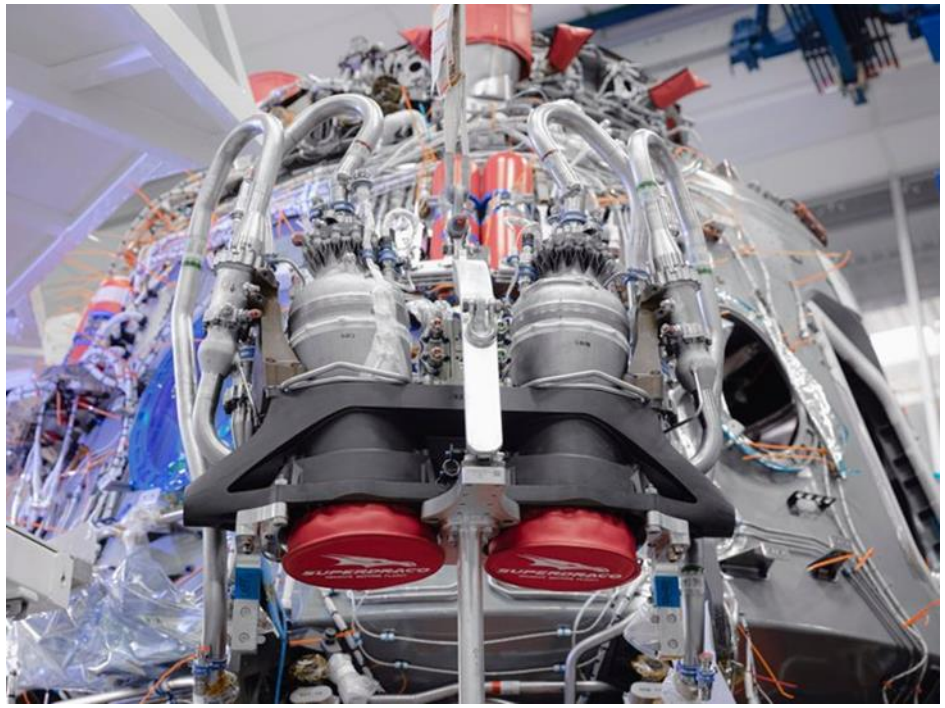
Dragon Launch Vehicle

- **Dragon** capsules are launched into **Low Earth Orbit (LEO**) atop the **Falcon 9** rocket
- Launch sites:
  - **Kennedy Space Center** Pad 39A
  - Space Launch Complex 40 at **Cape Canaveral Air Force Station**
- **Falcon 9** first stage returns after separation

Dragon Capsules

- **SuperDraco** is a **hypergolic propellant** rocket engine
- Eight **SuperDraco** engines provide fault-tolerant propulsion for use as a **launch escape system**
- **SuperDraco** rocket engines utilize a storable (non-cryogenic) **hypergolic propellant** which allows the engines to be fired many months after fueling and launch
  - Hypergolic fuels do not require an external source of ignition, providing increased reliability for the spacecraft
- The engines are used on **crew transport** flights to low Earth orbit
- While the engine is capable of 73,000 newtons (16,400 lbf) of thrust, during use for DragonFly testing, the engines will be throttled to 68,170 newtons (15,325 lbf) to maintain vehicle stability

Draco Engine



- **SuperDraco** combustion chamber has been created with additive manufacturing
- **Direct metal laser sintering (DMLS**), a type of 3D printing

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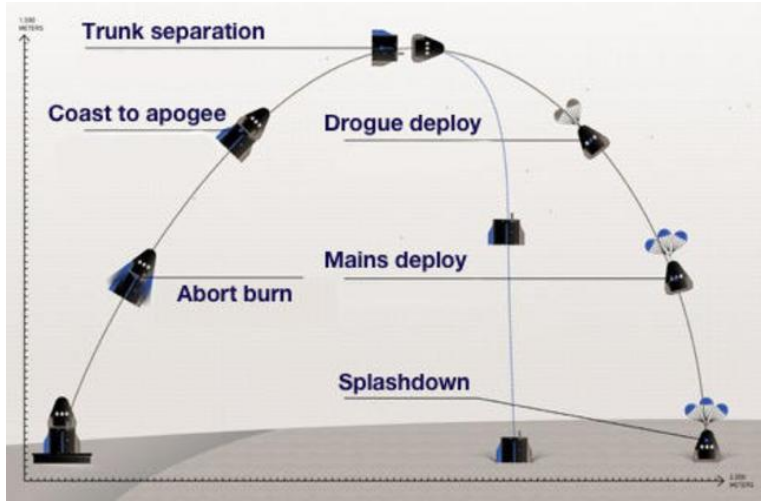
Dragon Capsule Abort System

- 8 **SuperDracos** that power the spacecraft's launch escape system
- The launch abort system is a crew safety system built into the **Dragon** spacecraft
- It is used to quickly separate **Dragon** from **Falcon 9** in the event of an emergency.



https://twitter.com/i/status/1187489139291119616

Dragon Capsules Draco Thrusters – Reaction Control System

- To maneuver in orbit and during re-entry, Dragon is equipped with 12 to 18 **Draco** Thrusters
- This small rocket engine was designed, developed and tested by **SpaceX**
- Each **Draco** engine provides 400 Newtons of thrust
- The engines are used for on-orbit maneuvers, attitude control and the long deorbit burn providing an extremely variable burn time
- **Draco** uses Nitrogen Tetroxide as Oxidizer and Monomethyl-hydrazine as fuel
- 1,290 Kilograms of propellants on-board of the Spacecraft are consumed over the course of the mission
- **Dragon's** Reaction Control System provides dual-redundancy in all axes
- Any two **Draco** engines can fail without mission impact

Draco Thruster

Dragon 1

Dragon Capsules Thermal Protections System / Heat Shield

- **SpaceX** worked in close operation to develop the heat shield of the **Dragon** Capsule that has to withstand up to 1,600°C during re-entry
- **PICA-X** is derived from NASA's **phenolic impregnated carbon ablator** heat shield, also called **PICA**
- This heat shield has a substantial flight heritage
- The **PICA-X** version is expected to be re-usable many times without showing a high degree of degradation
- This design can support re-entries at velocities exceeding typical speeds of **Low Earth Orbit Missions**
- No modifications would be required for a **Moon** or **Mars Flight**
- The heat shield was designed in less than four years
- It completed its successful flight verification on the **Dragon C1 Mission** in December 2010

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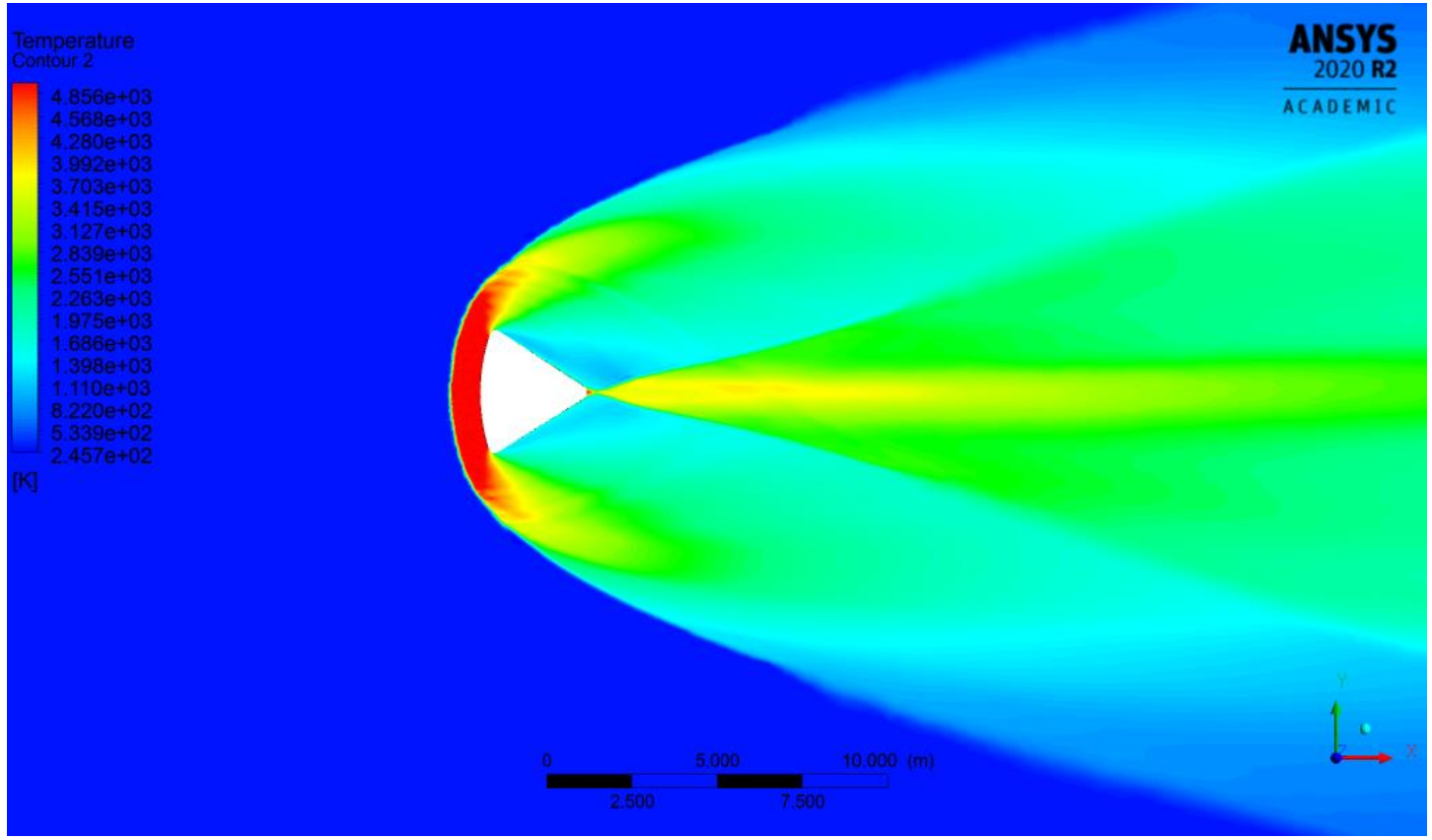
Dragon Capsules

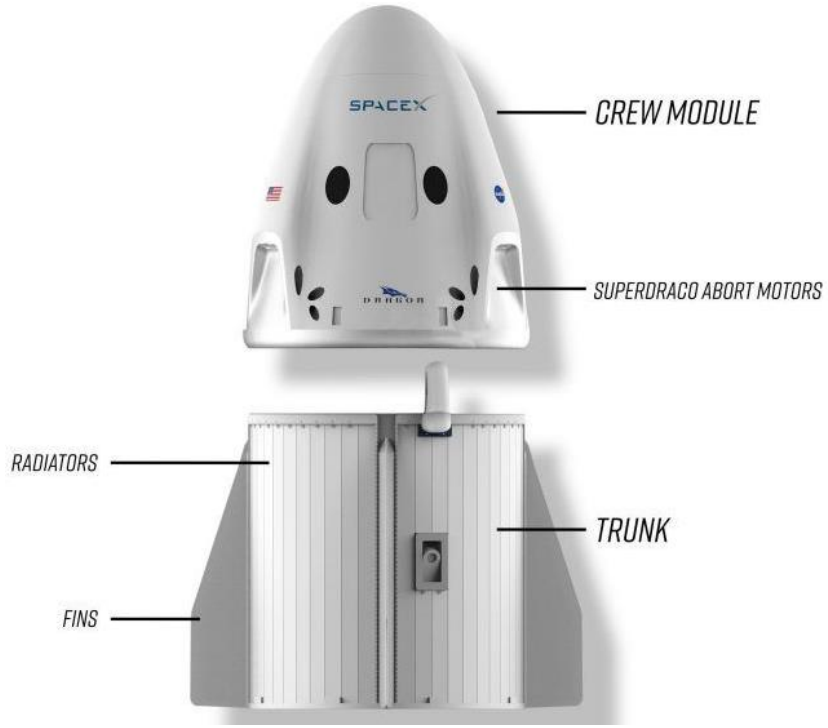
Thermal Protections System / Heat Shield

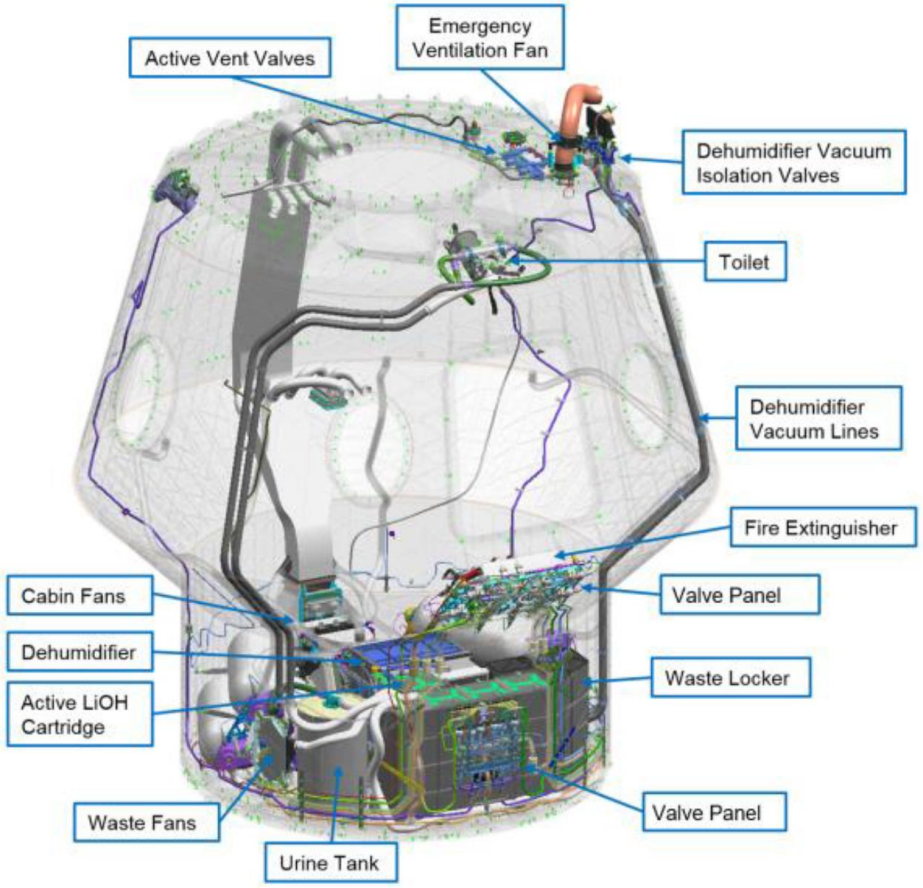


Reentry speeds ~7.8km/sec (4.8mi/sec)

Dragon Capsules Thermal Control System

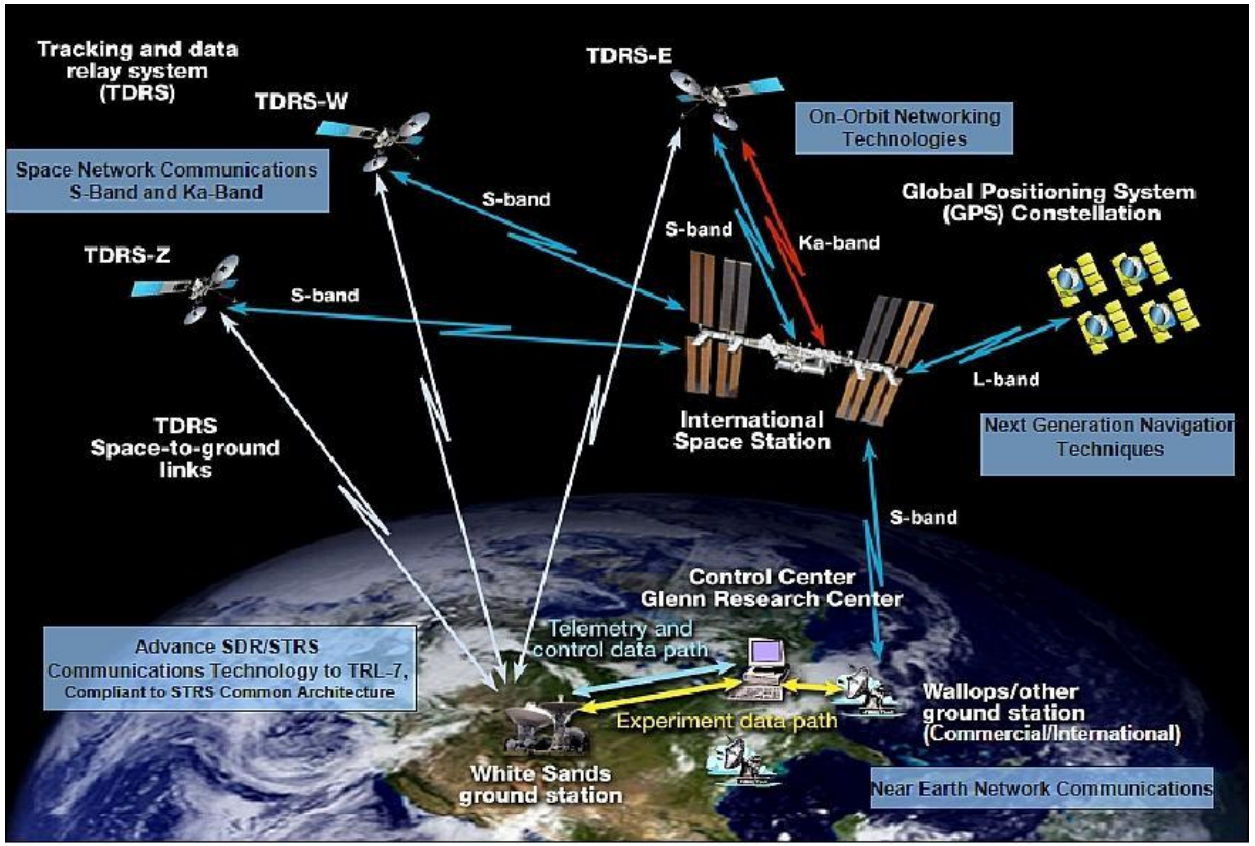
- To regulate Temperatures inside the Capsule while flying through the Space Environment, Dragon is outfitted with two fully redundant pumped fluid cooling loops
- **Radiators** are mounted to the Trunk's structure





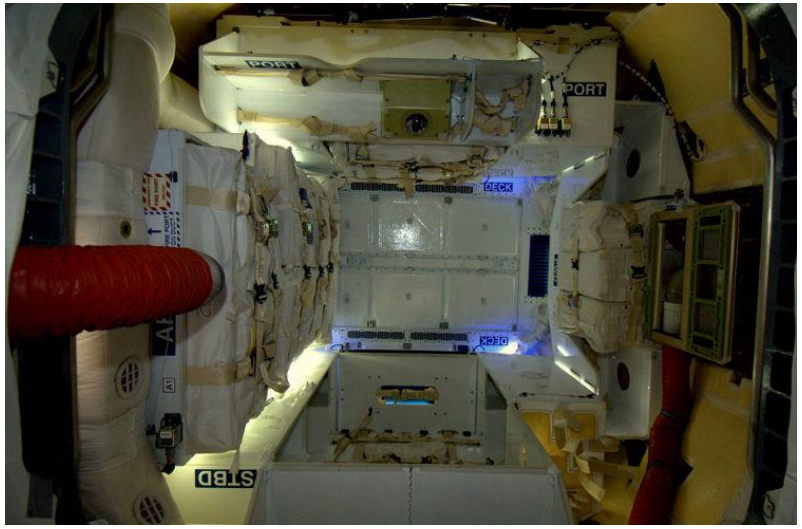
Dragon Capsules Comm & Telemetry

- **Dragon** supports communications via satellites such as **NASA's Tracking and Data Relay Satellite System**
- It is also capable of communicating via Ground Stations on Earth
- Data Rates are 300kbps for Command Uplink and 300Mbps or more for telemetry and data downlink
- Payloads on the Vehicle can be integrated via standard communication interfaces like Ethernet or RS-422 and 1553 standards
- Vehicle Communications are accomplished via redundant telemetry and video transmitters in S-Band
- Dragon is equipped with on-board compression and encryption/decryption systems

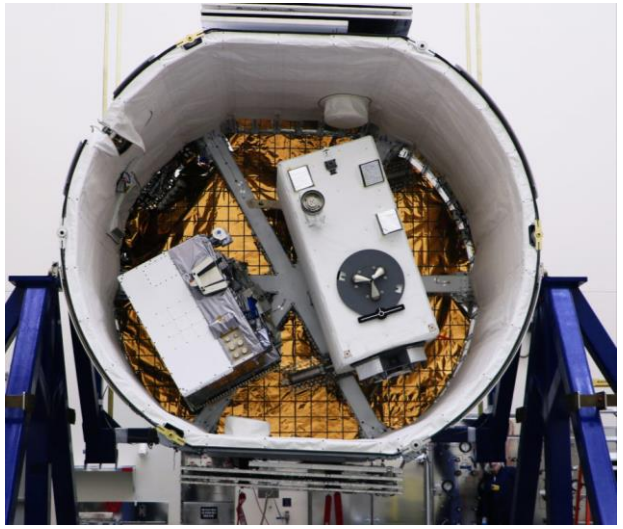


Dragon Capsules Payload Volume

- The habitable, pressurized Volume of the **Dragon Capsule** is 10m³
- In its regular configurations, 14m³of **trunk** volume are available for external payloads
- This '**trunk**' utilizes the volume beneath the capsule that is otherwise unused except for the Payload Adapter
- A trunk extension can boost the volume up to 34m³
- In the **Trunk**, electrical and fluid connections are available to accommodate a variety of Payloads including small satellites that can be released in orbit



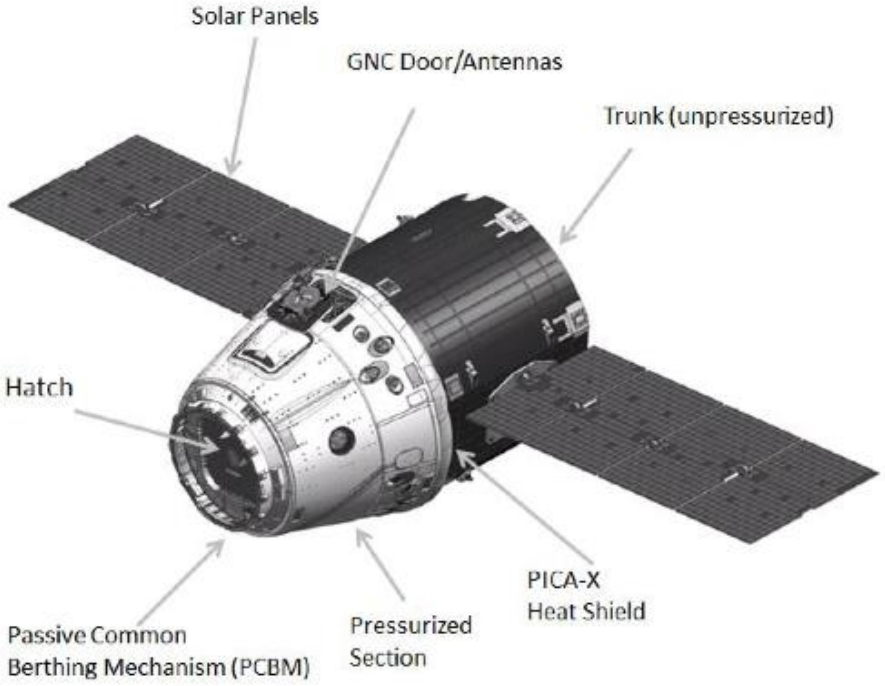
Dragon cargo payload



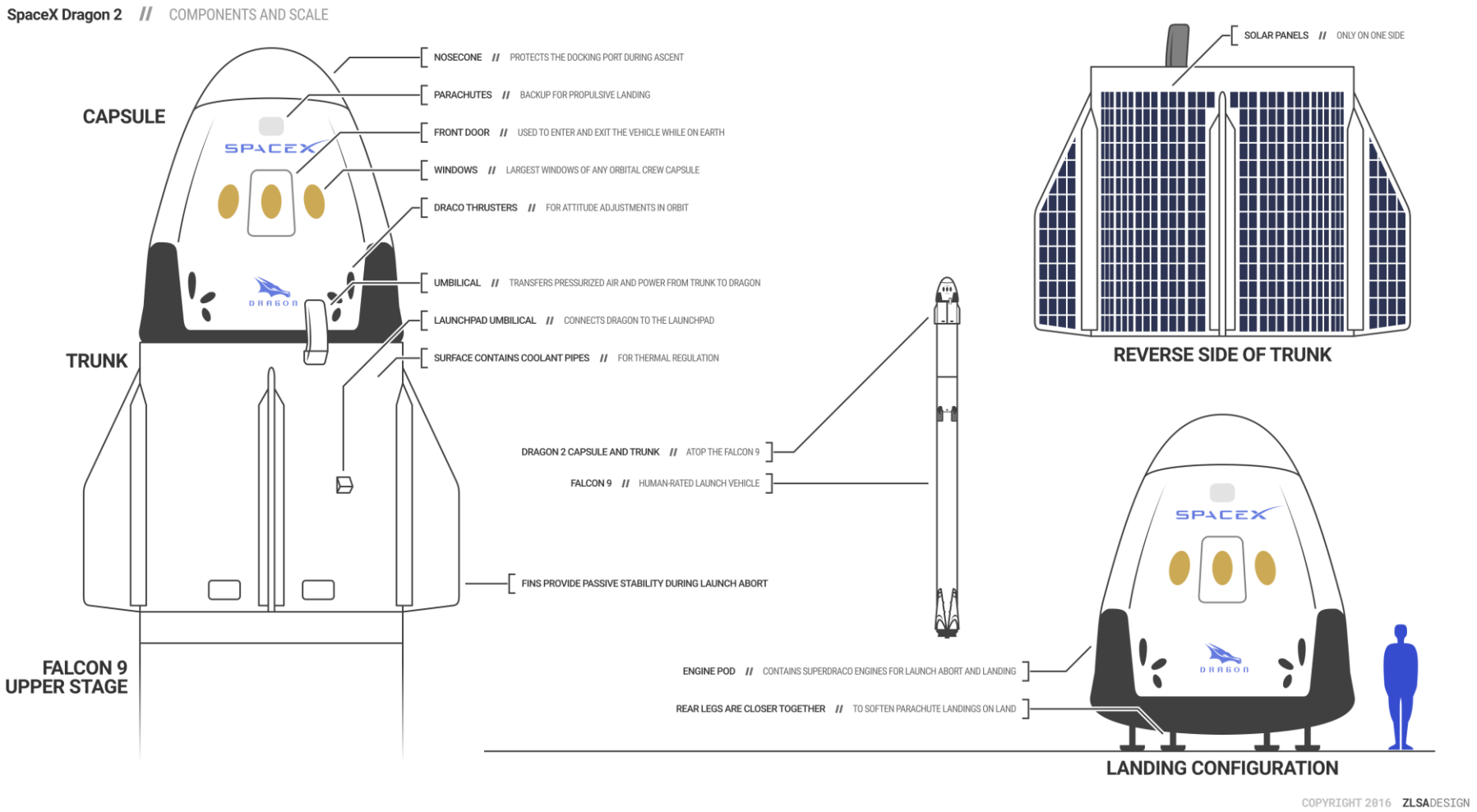
The Robotic Refueling Mission 3 (RRM3), at left, and the Global Ecosystem Dynamics Investigation (GEDI) are in the SpaceX Dragon unpressurized trunk.

Dragon 1 Capsule Power System

- Power is generated by two Solar Arrays that are deployed after orbital insertion and jettisoned before re-entry
- The arrays provide 1,500 to 2,000 Watts of power peaking up to 4,000 Watts
- Two Power Buses are part of Dragon's electrical system, providing 120 VDV and 28 VDC respectively
- 4 redundant Lithium-Polymer Batteries provide power during orbital night, ascent and re-entry

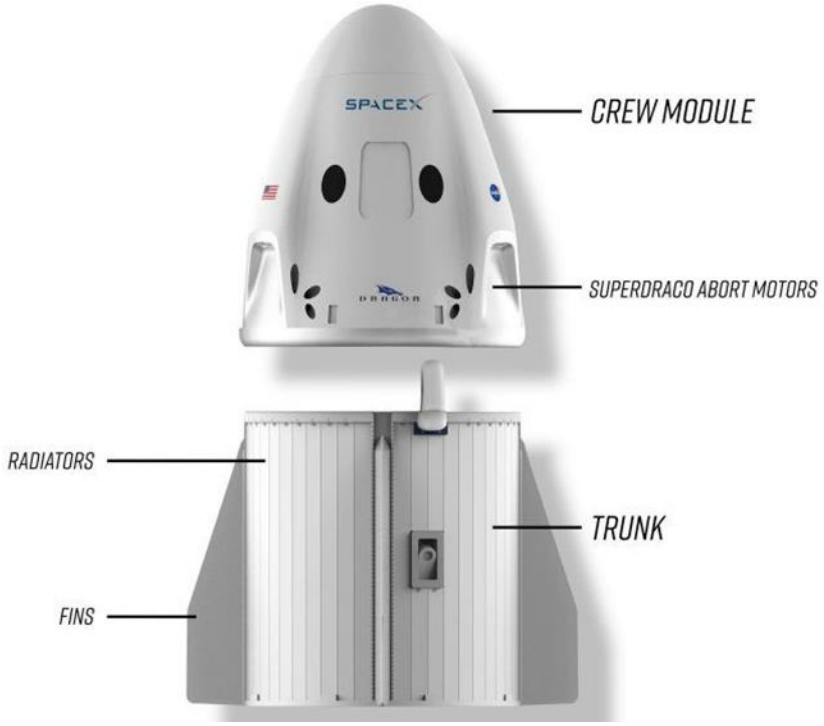


Dragon 2 Capsule Power System



Dragon 2 Capsule Environmental Control

- All aspects of the Cabin Environment can be controlled on **Dragon**
- Air Circulation is provided by several fans and sensors provide atmosphere measurements
- Internal Temperature and be adjusted between 10 and 46 degrees Celsius
- Internal Humidity and also be regulated within a range of 25-75% Relative Humidity
- The Capsule is pressurized up to 14.9psi and the pressure can be actively controlled as well
- To regulate Temperatures inside the Capsule **Dragon** is outfitted with two fully **redundant pumped fluid cooling loops**
- **Radiators** mounted to the Trunk's structure reject heat to space



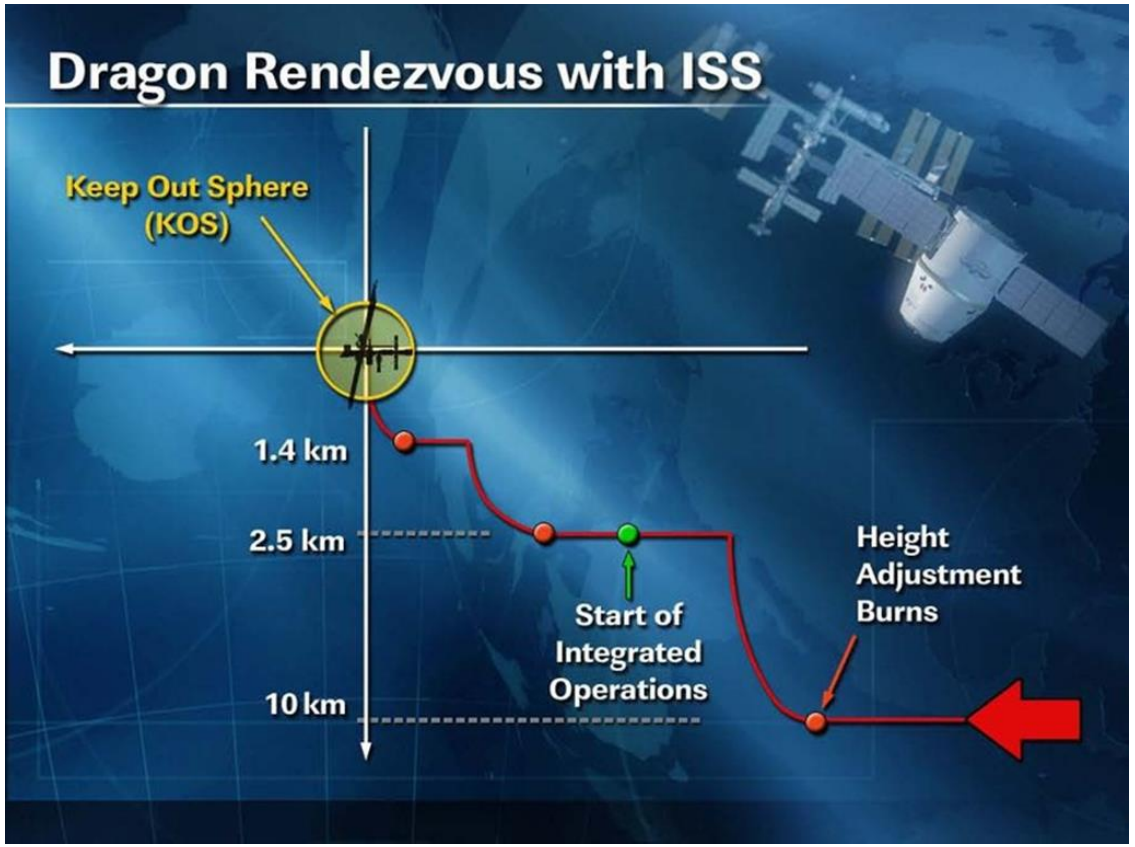
Dragon 1 Capsule Sensor Bay

- In addition to the external Payload Volume, **Dragon** has a small **Sensor Bay** that is located on the Sidewall of the Spacecraft
- It has a volume of 0.1m³ and is outfitted with a hatch mechanism that opens the hatch of the bay and deploys sensors or other payloads once in orbit
- Experiment Payloads can be exposed to the Space Environment and are protected during the Re-Entry Process by closing the hatch before re-entering the atmosphere

- Dragon 1

Dragon Capsules Guidance, Navigation and Control

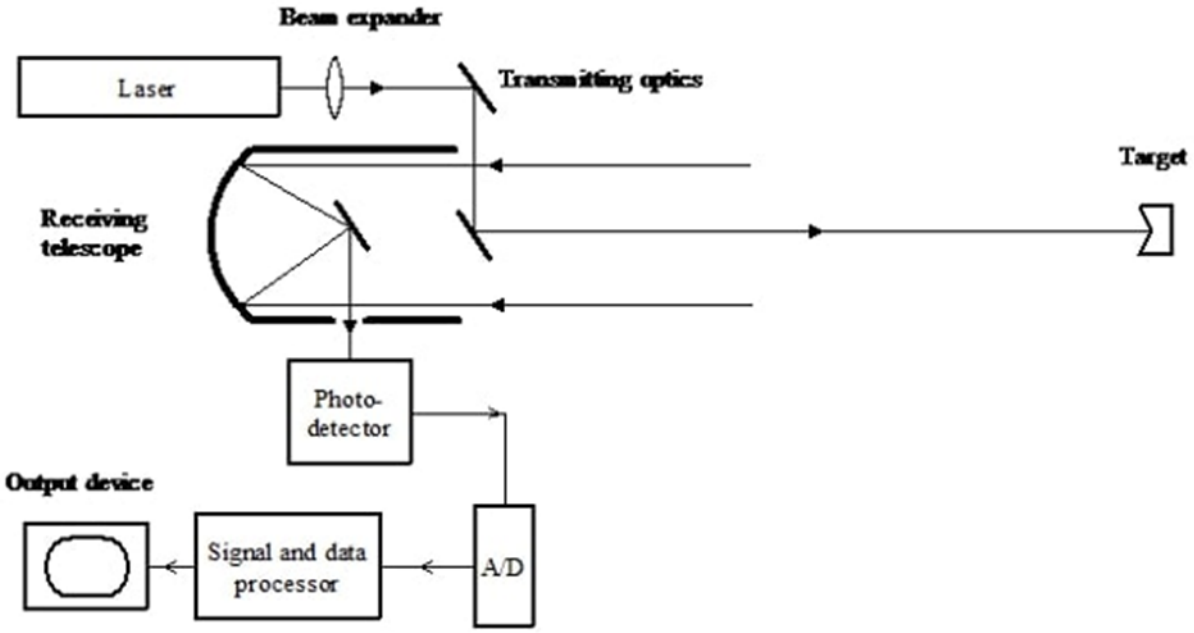
- For navigational purposes, Dragon is outfitted with **Inertial Measurement Units (IMU)** , **GPS Systems**, **Iridium Recovery Beacons** and **Star Trackers**
- **Attitude Control** and **Navigation** in orbit is accomplished with the **IMU** and **Star Trackers**
- Attitude Determination has an accuracy of 0.004 Degrees or smaller
- Attitude Control is 0.012 degrees on each axis in Station keeping Mode
- **Dragon** provides a **fully autonomous Rendezvous** and **Docking System**
- For manned missions, a manual docking is also possible by using the override function to control the vehicle by hand



Dragon Capsules Guidance, Navigation and Control

- **SpaceX** developed its **DragonEye Laser Imaging Detection and Ranging sensor (LIDAR)**
- The **DragonEye LIDAR** system provides three-dimensional images based on the amount of time it takes for a **single laser pulse** from the sensor to the reach a target and bounce back, providing **range** and **bearing information** from the **Dragon** spacecraft to the **ISS**.

- **DragonEye** aids in guiding the **Dragon** spacecraft as it approaches the ISS



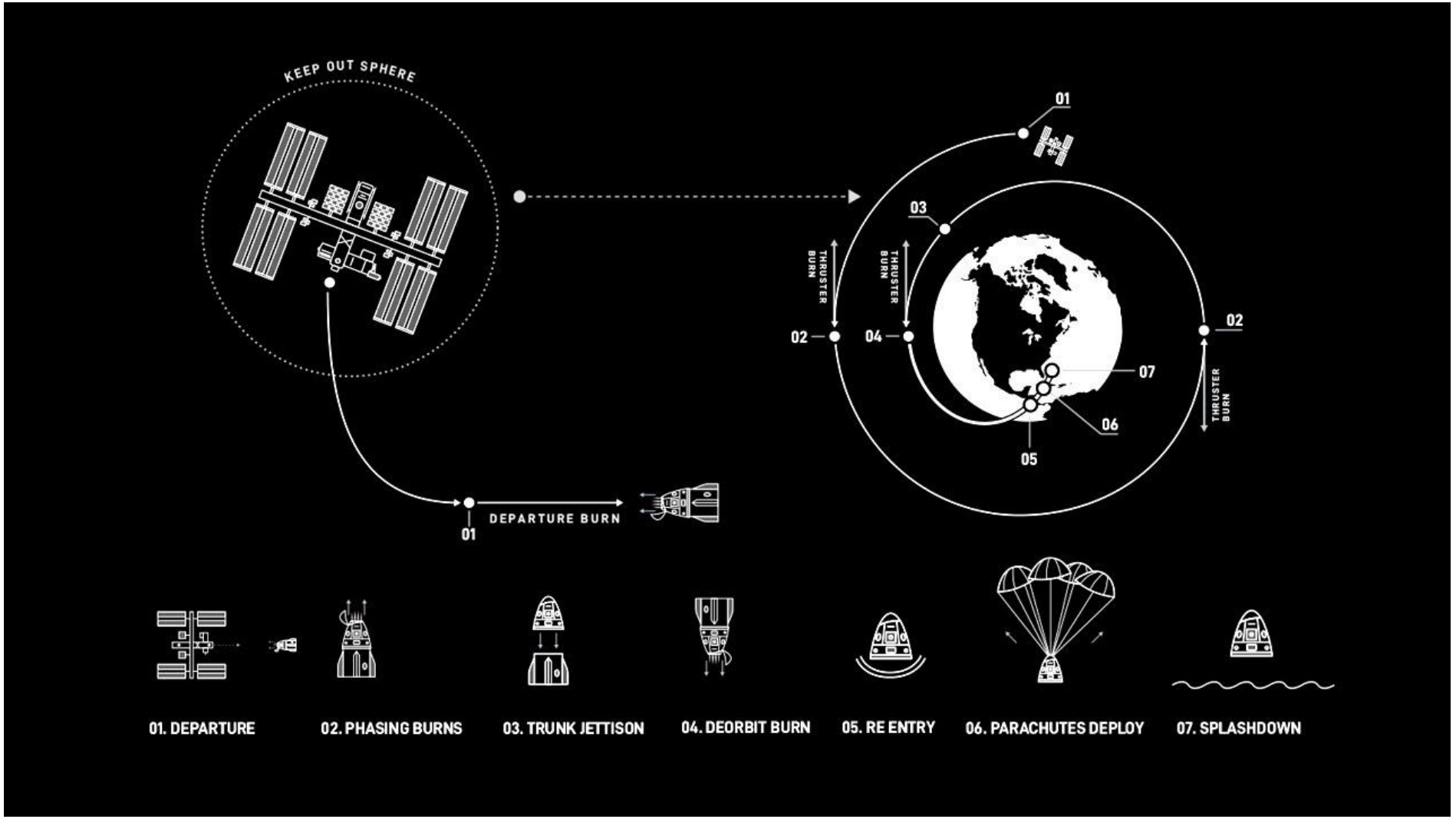
LIDAR is an “optical” RADAR

Dragon 2 Capsule Docking Systems

- **Dragon** can be equipped with different docking adapters such as **Integral Common Berthing Mechanism** with the low-impact docking system (LIDS)
- The Russian family of spacecraft docking mechanisms ,the **Androgynous Peripheral Attach System (APAS)**

The SpaceX Cargo Dragon and Crew Dragon vehicles are pictured docked to the Harmony module's international docking adapters

Dragon Return from ISS



Dragon Capsule Entry, Descent, Landing and Recovery

- **Dragon** is capable of performing a lifting re-entry to precisely target its landing area in the ocean
- During re-entry, **Dragon** experiences a low G-Load protecting experiments and the crew onboard
- Dual drogue parachutes slow and stabilize the craft before three main parachutes bring it to a gentle landing
- The Parachute System is also fully redundant
- After Splashdown, **GPS** and **Iridium Locator Be**acons can be used to locate the vehicle should in case of and off-target landing
- Recovery is done via ship and the capsule enters its refurbishment processing

- Total **Dragon** flights
  - 42 launches
  - 38 visits to **ISS**
  - 20 reflights

Next Session

Super Heavy booster and engines and Starship spacecraft

Electronics

- The Falcon 9 rocket uses a combination of **GPS and radar** to locate its landing pad or drone ship
- The rocket is programmed with the precise location of the landing pad or drone ship, and it uses GPS to guide itself to the general area
- Once it gets close enough, the rocket switches to radar to make a more precise landing
- The rocket's onboard computer uses the radar data to adjust its trajectory and ensure a safe landing

- **Optical sensors, laser-based range sensors, and inertial sensors** are used during **Dragon** free-flight and approach to the space station
- Redundant sensors are also connected to the fault-tolerant avionics suite, increasing the system's safety and reliability

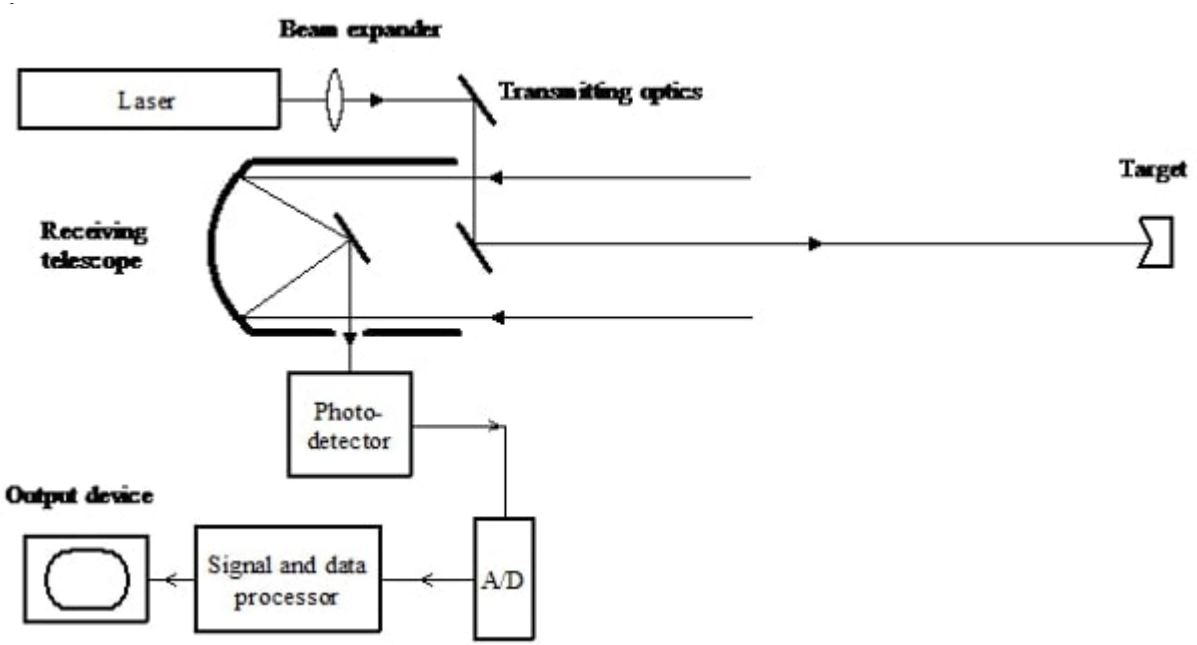
- Elon Musk tweeted that SpaceX developed and uses LIDAR for Dragon docking with the Space Station.

Electronics

- Astronauts need to know 2 things; the attitude the ship is in, and where the ship is
- Internal guidance can store both of these types of information with gyros and accelerometers, but it has to be updated
- So whereas the Apollo had an internal gyroscope that tracked the attitude, it was updated / corrected with star sightings by an astronaut
- Where the ship is, is tricker because it is not in a place, it is in a vector, and that changes constantly from one moment to the next
- A computer model of movement predicts it's trajectory and that needs to be updated as it drifts
- In earth orbit, the ship can be tracked from the ground where there are more people and many antennas to triangulate between
- Beyond earth (and GPS) like a trip to Mars, astronomical observation of the planets would have to be done to update the trajectory information
- Traditionally, just an inertial measurement unit
- More recently GPS has come into play as an additional sensor to better nail down the state
- Yes, a great deal of processing takes place to convert the data from the sensors into a filtered state, comparing that state to the desired state at that moment in time, and coming up with various commands, kept within their limits, to guide the vehicle back to the desired trajectory, as well as deciding when to cut off burns and stage

LIDAR

- LiDAR uses electromagnetic (EM) waves in the optical an infrared wavelengths. It is an active sensor, meaning that it sends out an EM wave and receives the reflected signa back
- It is similar to microwave radar, except at a much shorter wavelength
- A key advantage of mmWave radar is its imperviousness to adverse environmental conditions, such as smoke, fog and dust
- LIDAR is an acronym for LIght Detection And Ranging
- It is also called optical radar, laser radar or ladar under different application scenarios



DragonEye

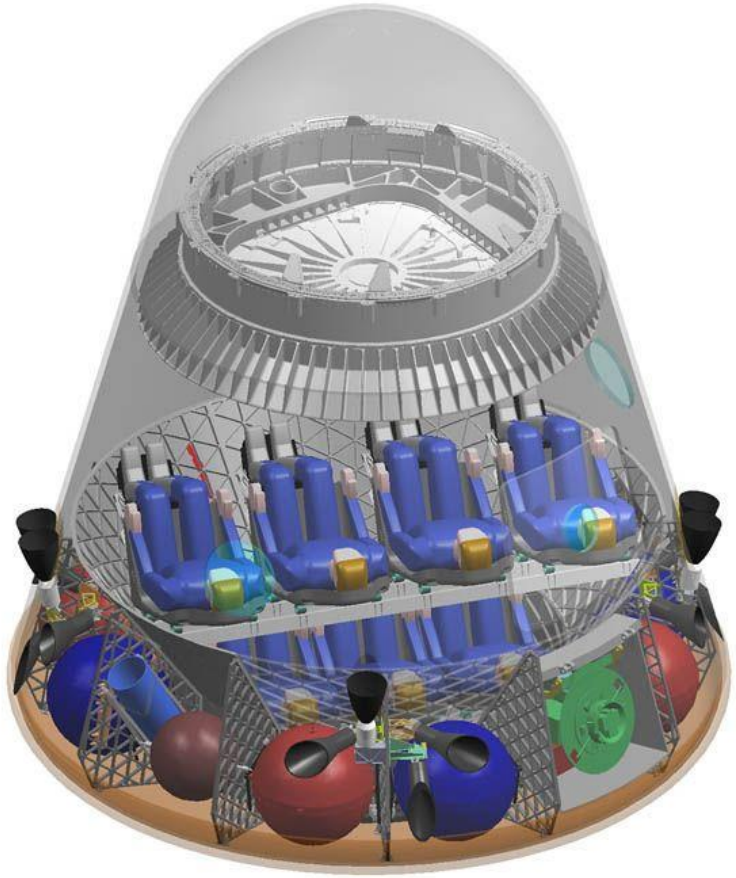
14 years ago |
09/27/2009
Space Exploration Technologies (SpaceX) recently announced the successful demonstration of a proximity sensor, called DragonEye, on NASA's STS-127 shuttle mission.
"The verification and functionality of SpaceX's DragonEye are a testament to the unique government-commercial partnership created by NASA's COTS program," said Gwynne Shotwell, President, SpaceX. "SpaceX appreciates NASA's support with DragonEye and is proud to be a part of a program that is shaping the future of American spaceflight."
DragonEye launched aboard the Space Shuttle Endeavour on July 15th, 2009, and was tested in proximity of the International Space Station (ISS) in preparation for future visits by SpaceX's Dragon spacecraft.

With the help of NASA's Commercial Crew and Cargo Program Office, DragonEye, a Laser Imaging Detection and Ranging (LIDAR) sensor, has undergone flight system trials aboard Space Shuttle Endeavour in preparation for guiding the Dragon spacecraft as it approaches the ISS. The DragonEye LIDAR system provides three-dimensional images based on the amount of time it takes for a single laser pulse from the sensor to the reach a target and bounce back, providing range and bearing information from the Dragon spacecraft to the ISS.

DragonEye will make its operational debut on the final flight of the Dragon spacecraft under NASA's Commercial Orbital Transportation Services (COTS) program, where the spacecraft will demonstrate the ability to berth with the ISS.
Developed in just 10 months from concept to final hardware, DragonEye was delivered to NASA's Kennedy Space Center on February 16th, 2009, for integration with the Space Shuttle Endeavour, successfully completing all of NASA's payload safety milestones.
Using flight data gathered onboard Space Shuttle Endeavour, DragonEye was able to detect the ISS and track it through various approach and departure maneuvers. Upon Endeavour's return, the DragonEye system was returned to SpaceX, where flight data from the sensor was retrieved and is currently under evaluation.
Together with SpaceX's Falcon 9 launch vehicle, the Dragon spacecraft is under contract with NASA to provide cargo resupply to the ISS when the Space Shuttle retires. This contract includes 12 flights between 2010 and 2015, with a guaranteed minimum of 20,000 kg of pressurized and unpressurized cargo to be carried to the ISS. SpaceX is the only COTS contender that has the capability to return cargo to Earth.

SPACEX

Dragon Capsule



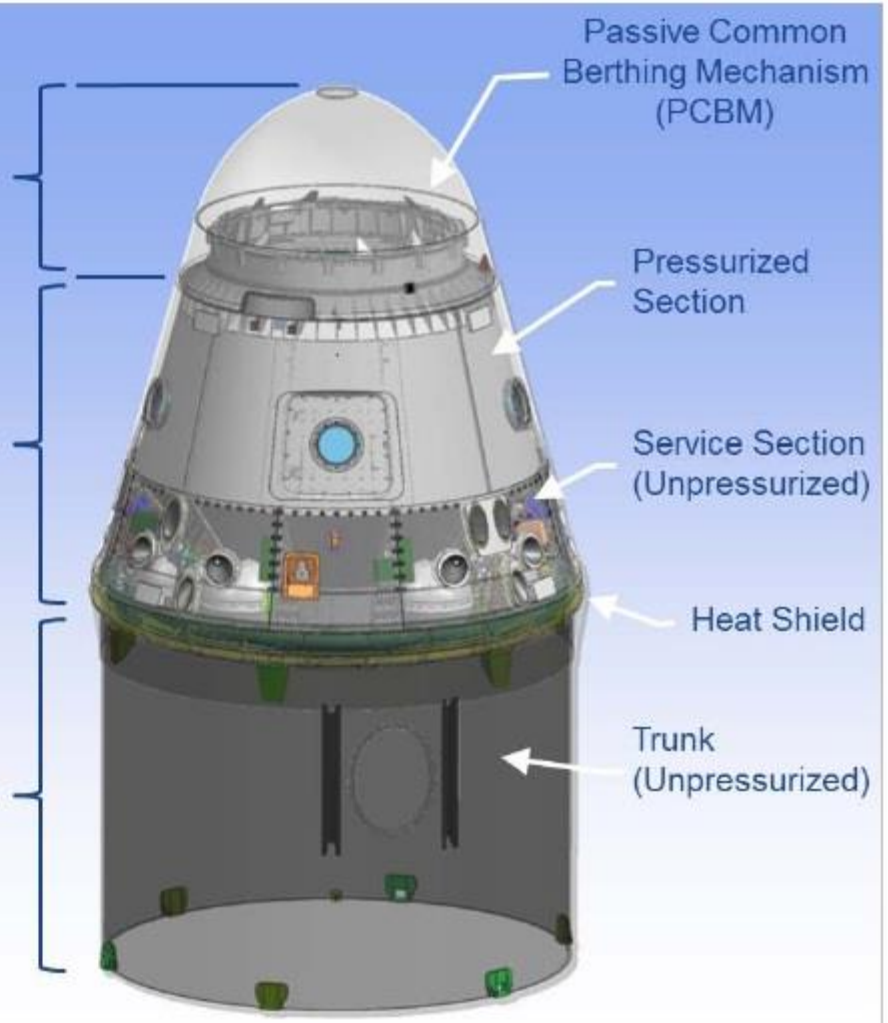
Interior

Dragon Capsules

Nosecone: Protects spacecraft and hatch during launch, jettisoned after stage separation.

Spacecraft: Recoverable. Equipped with hatches and windows, includes a pressurized section for cargo or crew with temperature controls and protection against radiation and micrometeorites, an unpressurized section for thrusters, propellant, and parachutes, and heat shield for thermal protection during reentry.

Trunk –Contains unpressurized cargo and small deployable satellites. Supports solar panels, thermal radiator. Jettisoned before reentry.



SpaceX and COTS

- The **Commercial Crew & Cargo Program** is responsible for challenging private industry to establish capabilities and services that can open new space markets while meeting the logistics transportation needs of the **International Space Station**
- By successfully providing reliable, cost-effective cargo and crew transportation services, **Commercial Crew & Cargo Program Office's (C3PO)** commercial partners can serve existing markets and develop new markets
- **SpaceX** has been the most aggressive company to take advantage of the **NASA** commercial space program

NASA- SpaceX COTS-2 Mission Animation
second test-flight for **SpaceX**'s uncrewed **Cargo Dragon**

It launched in May 2012 on the third flight of the company's two-stage **Falcon 9** launch vehicle

https://www.youtube.com/watch?v=dxNUlM5ArbY

NASA Commercial Funding and SpaceX

- **SpaceX** spent its own capital to develop the **Falcon 1**
  - First flight March 24, 2006
  - First satellite in orbit September 28, 2008
- Development of the **Falcon 9** was aided by partial **NASA** funding and commitments to purchase flights once specific capabilities were demonstrated
- **SpaceX** operated on a total of about $1 billion for its first ten years
  - About half came from government contract progress payments
- Funding started with seed money from the **Commercial Orbital Transportation Services (COTS)** program in 2006
- The contract was structured as a **Space Act Agreement (SAA)** "to develop and demonstrate commercial orbital transportation service , including the purchase of three demonstration flights
- The overall contract award was US$278 million to provide three demonstration launches of **Falcon 9** with the **SpaceX Dragon** cargo spacecraft
- Additional milestones were added later, raising the total contract value to US$396 million
- In 2008, **SpaceX** won a **Commercial Resupply Services (CRS)** contract to deliver cargo to ISS using **Falcon 9/Dragon**
- Funds were disbursed only after the demonstration missions were successfully and thoroughly completed
  - **Milestones**
- The contract totaled US$1.6 billion for a minimum of 12 missions to ferry supplies to and from **ISS**

SpaceX

- Enter low earth orbit aboard the SpaceX Dragon spacecraft. This fully autonomous, 4-passenger craft orbits the earth every 90 minutes and features Draco thrusters allowing for orbital manoeuvring, thus permitting a customised flight route. Fly over the Amazon River, the Great Barrier Reef, or the Pyramids of Giza, the choice is yours.
- This is the first space tourism experience provided using completely America technology as the Dragon will be launched by the companies Falcon 9 rocket, the same launch vehicle SpaceX uses to transport NASA astronauts to the International Space Station.
- Stellar Frontiers can negotiate a customised flight experience with SpaceX or can match you with one of their scheduled commercial spaceflight missions.

DRAGON

OVERVIEW

HEIGHT	8.1 m / 26.7 ft
DIAMETER	4 m / 13 ft
CAPSULE VOLUME	9.3 m^3 / 328 ft^3
TRUNK VOLUME	37 m^3 / 1300 ft^3
LAUNCH PAYLOAD MASS	6,000 kg / 13,228 lbs
RETURN PAYLOAD MASS	3,000 kg / 6,614 lbs

The Dragon spacecraft is capable of carrying up to 7 passengers to and from Earth orbit, and beyond. It is the only spacecraft currently flying that is capable of returning significant amounts of cargo to Earth, and is the first private spacecraft to take humans to the space station.

41	37	19
TOTAL LAUNCHES	VISITS TO THE ISS	TOTAL REFLIGHTS

Dragon Capsule

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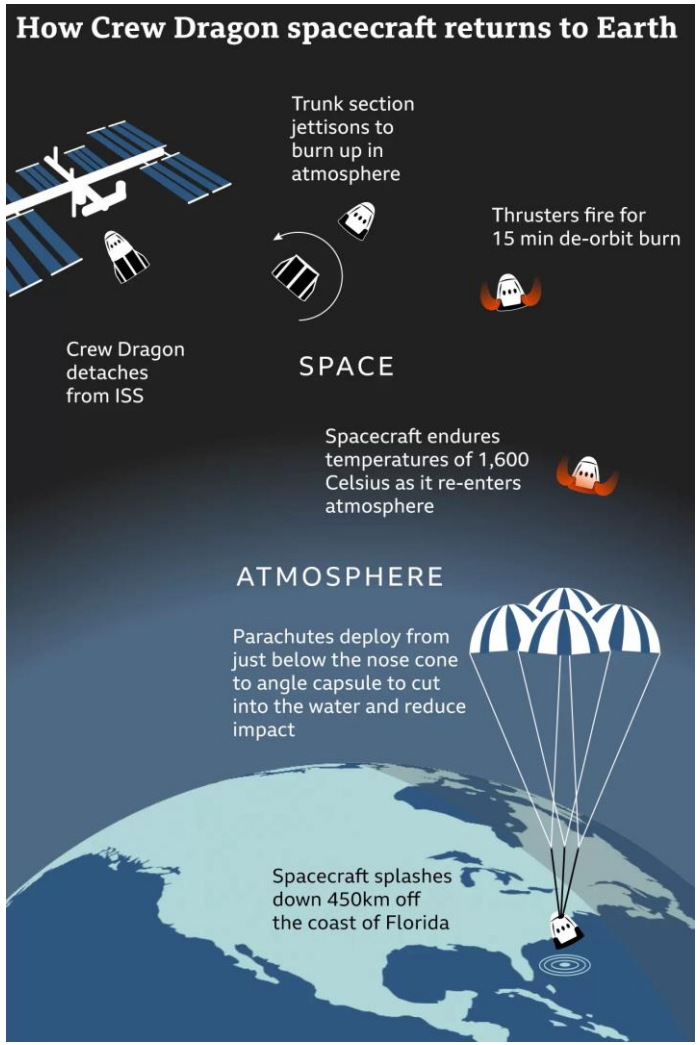
- It is the only spacecraft currently flying that is capable of returning significant amounts of cargo to Earth
- It is the first private spacecraft to take humans to the International Space Station (ISS)


SPACEX
DRAGON

Dragon Capsules

- SpaceX engineer John Federspiel, says the company had wanted to make Crew Dragon "feel like a 21st Century spaceship".
- He explains: "Probably one of the biggest features of Dragon are the touchscreens on the inside. We designed them not just to be very functional, but with a user experience in mind."
- The three large touchscreen displays that allow the commander and pilot to monitor and control the spacecraft are a world away from the analogue buttons and dials in the cockpits of previous vehicles such as the space shuttle.
- As the first humans assigned to fly on Crew Dragon, Hurley and Behnken worked closely with SpaceX to get the capsule ready for its historic launch in May 2020. The crew members - who had both previously flown on the shuttle - provided vital input.

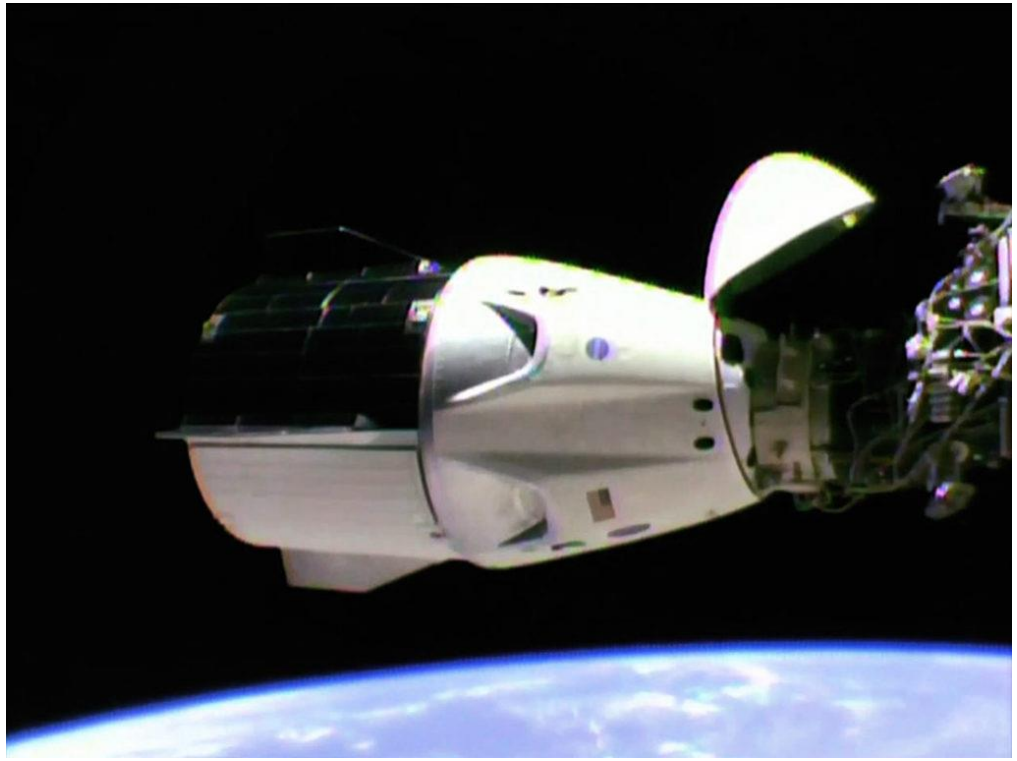
Dragon Capsules



Dragon Capsules

Dragon Capsules

- After making 18 orbits of Earth since its launch early Saturday morning, the Crew Dragon spacecraft successfully attached to the International Space Station's Harmony module forward port via "soft capture" at 5:51 a.m. EST while the station was traveling more than 250 miles over the Pacific Ocean, just north of New Zealand.
- As the spacecraft approached the space station, it demonstrated its **automated control** and maneuvering capabilities by arriving in place at about 492 feet (150 meters) away from the orbital laboratory then reversing course and backing away from the station to 590 feet (180 meters) before the final docking sequence from about 65 feet (20 meters) away.
- The Crew Dragon used the station's new international docking adapter for the first time since astronauts installed it during a spacewalk in August 2016, following its delivery to the station in the trunk of a SpaceX Dragon spacecraft on its ninth commercial resupply services mission.
- For the Demo-1 mission, Crew Dragon is delivering more than 400 pounds of crew supplies and equipment to the space station. A lifelike test device named Ripley also is aboard the spacecraft, outfitted with sensors to provide data about potential effects on humans traveling in Crew Dragon.
- The Crew Dragon is designed to stay docked to station for up to 210 days, although the spacecraft used for this flight test will remain docked to the space station only five days, departing Friday, March 8.
- More details about the mission and NASA's commercial crew program can be found in the press kit online and by following the commercial crew blog, @Commercial_Crew and Commercial Crew on Facebook.



Dragon Capsules